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Applicant: Kyushu Electric Power Co., Inc.

Title: METHOD FOR MANAGING CATALYST IN FLUE-GAS DENITRATION EQUIPMENT OF THERMAL POWER STATION

(54) [Title of the Invention] Method for managing catalyst in flue-gas denitration equipment of thermal power station

[Scope of Claim for Patent]

[Claim 1] A method for managing a catalyst in flue-gas denitration equipment of a thermal power station in which the flue-gas denitration equipment adds ammonia to upstream flue gas of a plurality of catalyst layers, wherein a plurality of flue gas measuring holes are provided between the catalyst layers at intervals from one another in a direction of flow of the flue gas, measuring devices are inserted from the measuring holes to periodically measure a concentration of NOx and a concentration of unreacted NH₃, and a denitration rate and a load rate of each catalyst layer are calculated from the NOx concentration, thereby

- (1) monitoring a deterioration state of the catalyst performance, and
- (2) specifying a catalyst having the deteriorated performance.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to a method for managing catalysts in flue-gas denitration equipment for dissolving NOx from flue gas of a large boiler used in a thermal power station by means of dry ammonia contact selection reduction method (catalyst function).

[0002]

[Conventional art] In denitration equipment in Minato Electric Generating Station of Kyushu Electric Power Co., Inc., first to third catalyst layers were provided on April, 1983 when a burning system was changed to a coal-burning system. Thereafter, a catalyst was added as an A layer (a former dummy layer) and a fourth layer for an air preheater closing countermeasure (unreacted NH₃ reduction countermeasure) on July, 1985, and the first

layer catalyst was replaced by a new one on December, 1986, and there is no further change to date (see Figs. 1).

[0003] At first, the catalyst performance was managed by measuring gas (a concentration of NOx and a concentration of unreacted NH₃) only at an outlet and an inlet (two locations) of the denitration equipment, but it was not possible to grasp the deterioration of the catalyst performance of each catalyst layer, and there is a problem that it is difficult to appropriately correct remedy or improve the catalyst.

[0004]

[Problem to be Solved by the Invention]

Main factors which deteriorate the denitration rate are (1) adherence of coal ashes to a catalyst surface, (2) fracture or loss of catalyst, (3) deterioration with time of the catalyst (poisoning of the catalyst caused by Na, K or the like). In view of this fact, it is an object of the present invention to measure a concentration of NOx and a concentration of unreacted NH₃ with respect to each of the plurality of the catalyst layers, to calculate the denitration rate of each catalyst layer from the NOx concentration, thereby strengthening the management of the catalyst performance, reproducing the catalyst performance and elongating the durability lifetime.

[0005]

[Means for Solving the Problem]

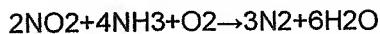
To achieve the above object, the present invention provides a method for managing a catalyst in flue-gas denitration equipment of a thermal power station in which the flue-gas denitration equipment adds ammonia to upstream flue gas of a plurality of catalyst layers, wherein a plurality of flue gas measuring holes are provided between the catalyst layers at intervals from one another in a direction of flow of the flue gas, measuring devices are inserted from the measuring holes to periodically measure a concentration of NOx and a concentration of unreacted NH₃, and a denitration rate and a load rate with respect to each catalyst layer are calculated from the concentration of NOx, thereby

- (1) monitoring deterioration state of the catalyst performance, and
- (2) specifying a catalyst having the deteriorated performance.

[0006]

[Operation] If ammonia is added to boiler flue gas to pass through the plurality of the catalyst layers as shown in Figs. 1, the following reaction occurs to decompose NOx in the flue gas into nitrogen and water.

[0007]



In this case, coal ashes (fine powder) are included in the boiler flue gas, the fine powder is deposited on the surfaces of the respective catalyst layers A, 1, 2, 3 and 4, and the catalyst abilities of the respective catalyst layers A, 1, 2, 3 and 4 are deteriorated due to fracture or loss of the catalyst or deterioration with time as described above. Thus, the concentration of NO_x and the concentration of the unreacted NH₃ are periodically measured in the intervals *t* between the catalyst layers, a denitration rate (%) and a load rate (%) of the respective catalyst layers A, 1, 2, 3 and 4 are calculated from the NO_x concentration. As a result, it is possible to monitor the deterioration state of the catalyst performance and to specify a catalyst layer having the deteriorated performance.

[0008]

[Embodiments] As shown in Fig. 4, a flue gas duct 6 connected to a combustion furnace 7 of a boiler is connected to a chimney 8 so as to interpose a denitration catalyst layer accommodating chamber 9 connecting to the duct 6. An ammonia supply tube 10 is opened in the duct 6 upstream of the accommodating chamber 9 so that ammonia is added. As shown in Figs. 1, in the accommodating chamber 9, a plurality of catalyst layers A, 1, 2, 3 and 4 and a plurality of (five) gas measuring holes 12 are provided in a multi-stacked manner at intervals to form a plurality of catalyst layers. A concentration of NO_x and a concentration of reacted NH₃ are periodically measured using gas measuring devices inserted from the gas measuring holes 12. A denitration rate (%) and a load rate (%) of the respective catalyst layers A, 1, 2, 3 and 4 are periodically calculated from the NO_x concentration. As a result, it is possible to monitor the deterioration state of the catalyst performance and to specify a catalyst layer having the deteriorated performance. Concerning the catalyst layer having the deteriorated performance by adherence of coal ashes (fine powder) thereto, the coal ashes are removed from the catalyst accommodating chamber 9 by blowing air or the like. As a result, improvement in the denitration rate and the unreacted NH₃ can be achieved.

[0009] (Result of measurement) To verify the monitor of deteriorated state of the performance and specification of catalyst having the deteriorated performance using an actual machine, the concentration of NO_x and the concentration of the unreacted NH₃ were measured in the flue gas measuring holes of the denitration equipment (catalyst) that was

previously cleaned, and the denitration rate and the load rate of each catalyst layer were calculated from the concentration of NOx.

[0010] (1) The denitration rate of each catalyst layer immediately after the cleaning of the denitration equipment is higher as closer to the upstream of the gas flow, and the denitration reaction proceeds as closer to the upstream of the gas flow as shown in Fig. 2.

[0011] (2) Concerning the load rate and the denitration rate of each catalyst layer immediately after the cleaning of the denitration equipment, the denitration load rate of each layer when the total denitration rate is defined as 100% is shown in Fig. 2. The catalyst layer A bears 50%, the catalyst layer 1 bears 30%, and both the two catalyst layers A and 1 upstream of the gas flow bear about 80% of the total denitration effect.

[0012] (3) The NH₃ (unreacted NH₃) at outlets of the unreacted NH₃ catalyst layers 2, 3 and 4 immediately after the cleaning of the denitration equipment are sequentially reduced and are 4.4 ppm, 1.8 ppm and 0.6 ppm, respectively. The unreacted NH₃ of the final catalyst layer 4 clears the limit value (3 ppm) for preventing the air preheater disposed behind the denitration equipment from being closed.

[0013] (4) Denitration rate of each catalyst layer after one month from the cleaning of the denitration equipment

a. If the denitration rates of the catalyst layers A and 1 are compared to those immediately after the cleaning, the respective denitration rates of the catalyst layers A and 1 are reduced (22% to 14%, 18% to 10%) as shown in Fig. 3. This allows to monitor the deterioration of the catalyst performance and specify a catalyst having the deteriorated performance.

b. Denitration rate of the catalyst layer 2

Since the denitration rates of the catalyst layers A and 1 is deteriorated, NOx flows into the catalyst layer 2 in a high concentration. As a result, the denitration rate of the catalyst layer 2 is increased.

c. The denitration rates of the catalyst layers 3 and 4 are not especially varied.

[0014] (5) Load rate of each catalyst layer after one month from the cleaning of the denitration equipment

Fig. 3 depicts a load rate of each catalyst layer after one month from the cleaning of the denitration equipment. As seen in Fig. 3, since the denitration rates of the catalyst layers A and 1 are deteriorated, NOx flows into the catalyst layer 2 in a high concentration, the denitration reaction of the catalyst layer 2 is increased, the load rate of the catalyst layer 2 was largely increased from 11% to 44% as compared with the value immediately after the

cleaning.

[0015] (6) Unreacted NH₃ after one month from the cleaning of the denitration equipment

The unreacted NH₃ at outlets of the catalyst layers 2, 3 and 4 after one month from the cleaning of the denitration equipment are sequentially deteriorated and are 5.4 ppm, 2.9 ppm and 1.3 ppm, respectively as shown in Fig. 3. The unreacted NH₃ of the final catalyst layer 4 clears the limit value (3 ppm) for preventing the air preheater from being closed, but is slightly increased as compared with a value immediately after the cleaning of the denitration equipment. This is because that the performances of the catalyst layers 1 and 2 are deteriorated.

[0016] Among catalyst layers having deteriorated performance, for one caused by adherence of coal ashes, air blowing can be considered as a countermeasure, for one caused by fracture or loss, replacement of catalyst in a periodic repair can be considered as a countermeasure, and for one caused by deterioration with time of catalyst itself (poisoning of catalyst by Na, K or the like), establishment of removing technique of poisoning material (reproduction of catalyst) can be considered as a countermeasure. In Fig. 1, reference numeral 11 represents coal ash collecting hopper, and reference numeral 12 represents the gas measuring hole.

[0017]

[Effect of the Invention]

According to the present invention, it is possible to:

- (1) monitor the deteriorated state of the catalyst performance; and
- (2) specify a catalyst having the deteriorated performance. Thus, it is possible to reproduce the catalyst performance and to elongate the durability lifetime by processing such as air blowing against the catalyst layer.

[Brief Description of Drawings]

[Fig. 1] Fig. 1(a) is a side view of a disposition state of a plurality of catalyst layers of the present invention, Fig. 1(b) depicts a flue gas measuring hole of the invention in Fig. 1(a), and Fig. 1(c) depicts a conventional flue gas measuring hole in Fig. 1(a).

[Fig. 2] A graph showing a denitration rate, a load rate, and a concentration of unreacted NH₃ of each catalyst layer immediately after cleaning operation.

[Fig. 3] A graph showing a denitration rate, a load rate, and a concentration of unreacted NH₃ of each catalyst layer immediately after one month from the cleaning operation.

[Fig. 4] A perspective view for explaining flue-gas denitration equipment.

[Explanation of Reference numerals]

- 6 Flue gas duct
- 7 Combustion furnace of boiler
- 8 Chimney
- 9 Denitration catalyst layer accommodating chamber
- 10 Ammonia supply tube

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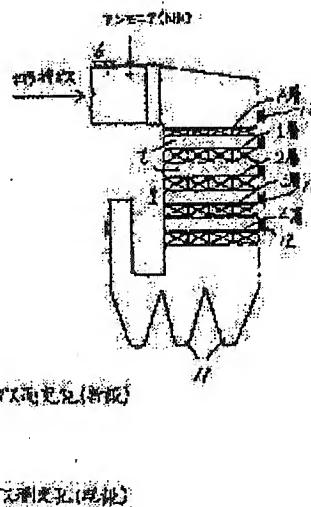
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(54) METHOD FOR CONTROLLING CATALYST FOR DENITRATOR OF FLUE GAS IN THERMAL POWER PLANT

(57)Abstract:

PURPOSE: To recognize the declining state in the performance of plural catalytic layers in reference to a denitration equipment which decomposes NOx in the flue gas of a boiler at a thermal power plant.

CONSTITUTION: The boiler flue gas is passed through the plural catalytic layers arranged in plural steps, and by periodically measuring the denitration ratio (%) of each catalytic layer A, 1, 2, 3, 4, a burden ratio (%) and the concentration of a leakage NH3, the declining state in the performance of each catalytic layer is monitored and specified.



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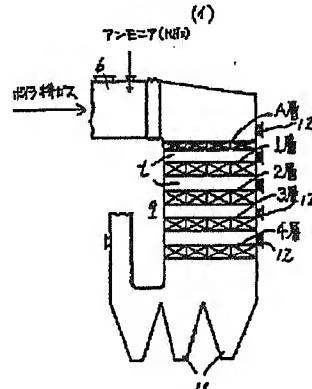
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(54)【発明の名称】火力発電所排煙脱硝装置の触媒管理法

(57)【要約】

【目的】火力発電所のボイラの排ガスからNO_xを分
解する脱硝装置において、複数触媒層の性能の低下状態
を把握する。

【構成】ボイラ排ガスを複数段に設けた複数触媒層を
通過させ、各触媒層A、1、2、3、4層の脱硝率
(%)、負担率(%)及びリーコNH₃濃度を定期的に
測定することにより各触媒層の性能の低下状況を監視及
び特定するものである。



(2) 排ガス測定孔(新設)

(3) 排ガス測定孔(既設)

1

【特許請求の範囲】

【請求項1】複数触媒層の上流側排ガスにアンモニアを添加する排煙脱硝装置において、複数の排ガス測定孔を同排ガスの流れの方向に間隔を介して複数触媒層間に配設し、同複数触媒層の各層について上記測定孔から挿入した測定器によってNO_x濃度及び未反応NH₃濃度を定期的に測定する。NO_x濃度からは各触媒層の脱硝率及び負担率を算出することにより、

- (1)触媒の性能低下状況の監視
- (2)性能の低下した触媒の特定

10 行なうことを特徴とする火力発電所排煙脱硝装置の触媒管理法。

【発明の詳細な説明】

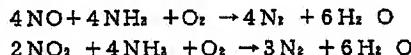
【0001】

【産業上の利用分野】本発明は火力発電に用いられる大型ボイラの排ガスからNO_xを乾式アンモニア接触選択性元法(触媒作用)によって分解処理する排煙脱硝装置の触媒管理法に関するものである。

【0002】

【従来の技術】九州電力株式会社港発電所の脱硝装置は、石炭専焼化に伴い昭和58年4月に第1～第3層の触媒層が設置されたもので、その後空気予熱器閉塞対策(未反応NH₃低減対策)として昭和60年7月にA層(元ダミー層)及び第4層として触媒を追設し、昭和61年12月に第1層触媒を取替えて現在に至っている(図1参照)。

【0003】当初触媒の性能管理としては、脱硝装置の出入口(2箇所)のみのガス測定(NO_x濃度及び未反応NH₃濃度)によって管理していたが、それだけでは各触媒層の触媒性能の低下を把握することが出来ず触媒*



この場合、ボイラ排ガスには石炭灰(微細粉体)が含まれており、同微細粉体が各触媒層A、1、2、3、4の表面に堆積したり、又前述のように触媒の破損欠落及び経年劣化等によって各触媒層A、1、2、3、4の触媒性能が低下する。そのため各触媒層間の間隔tにおいてNO_x濃度及び未反応NH₃濃度を定期的に測定しNO_x濃度からは各層A、1、2、3、4の脱硝率(%)及び負担率(%)を算出することにより性能の低下状況を監視し、又性能の低下した触媒層を特定することができる。

【0008】

【実施例】図4に示すようにボイラの燃焼炉7に接続した排ガスダクト6は煙突8に接続し、同ダクト6に脱硝触媒層収容室9を介設する。そして同収容室9の上流側にアンモニア供給管10をダクト6内に開口し、アンモニアを添加するものである。上記収容室9には図1に示すように複数の触媒層A、1、2、3、4及び複数(5個)のガス測定孔12を間隔tを介して複数段に配設し

2 *の適時、的確な補修又は改良が困難である等の問題があつた。

【0004】

【発明が解決しようとする課題】本発明は脱硝率を低下させる主要因が①触媒表面への石炭灰の附着②触媒の破損、欠落③触媒そのものの経年劣化(Na、K等による触媒の被毒等)によるものであることに鑑み、複数触媒層の各層についてNO_x濃度及び未反応NH₃濃度を測定して、NO_x濃度からは触媒各層毎の脱硝率を算出することにより触媒性能の管理を強化し、触媒性能の再生及び耐用命数の延伸を計ることを目的とする。

【0005】

【課題を解決するための手段】上記の目的を達成するため本発明は複数触媒層の上流側排ガスにアンモニアを添加する排煙脱硝装置において、複数の排ガス測定孔を同排ガスの流れの方向に間隔を介して複数触媒層間に配設し、同複数触媒層の各層について上記測定孔から挿入した測定器によってNO_x濃度及び未反応NH₃濃度を定期的に測定する。NO_x濃度からは各触媒層の脱硝率及び負担率を算出することにより、

- (1)触媒の性能低下状況の監視
- (2)性能の低下した触媒の特定

10 行なうことを特徴とする火力発電所排煙脱硝装置の触媒管理法によって構成される。

【0006】

【作用】図1に示すようにボイラ排ガスにアンモニアを添加し複数の触媒層を通してすると次の反応が行われて排ガス中のNO_xは窒素と水に分解される。

【0007】

40 て複数触媒層が形成される。上記ガス測定孔12から挿入したガス測定器によってNO_x濃度及び未反応NH₃濃度を定期的に測定する。NO_x濃度からは各触媒層A、1、2、3、4の脱硝率(%)及び負担率(%)を定期的に算出することにより性能の低下状況を監視し性能の低下した触媒を特定できる。前述の石炭灰(微細粉体)の附着により性能の低下している触媒層については、それらをエヤー吹かし等の処理により触媒収容室9外に除去することによって脱硝率及び未反応NH₃を改善することが出来る。

【0009】(測定結果)性能の低下状況の監視及び性能の低下した触媒の特定を実機で検証するため、あらかじめ清掃を行った脱硝装置(触媒)の各排ガス測定孔においてNO_x濃度及び未反応NH₃濃度を測定し、NO_x濃度からは各触媒層の脱硝率及び負担率を算出した。

50 【0010】(1)脱硝装置清掃直後の各触媒層脱硝率各触媒層の脱硝率は、図2に示す様にガス上流側ほど高くなつておらず、ガス上流側ほど脱硝反応が進むことを示し

ている。

【0011】(2) 脱硝装置清掃直後の各触媒層負担率各層の脱硝率について、総合脱硝率を100%とした場合の各層脱硝負担率を図2に示す。これから触媒層Aで50%、触媒層1で30%負担しており、ガス上流側の2つの触媒層A、1で約80%の脱硝効果を示している。

【0012】(3) 脱硝装置清掃直後の未反応NH₃触媒層2、3及び4の出口のNH₃ (未反応NH₃) は図2に示すようにそれぞれ4.4 ppm、1.8 ppm、0.6 ppmと順次低下している。最終触媒層4の未反応NH₃は、脱硝装置の後に設置されている空気予熱器の閉塞を防止するための制限値 (3 ppm) をクリヤしている。

【0013】(4) 脱硝装置清掃後1箇月後の各触媒層脱硝率a、触媒層A及び触媒層1の脱硝率清掃直後と比較すると触媒層A及び触媒層1の脱硝率は図3に示すようにそれぞれ (22%→14%、18%→10%) 低下している。これにより、触媒の性能の低下を監視でき、且つ性能の低下した触媒を特定することが出来る。

b、触媒層2の脱硝率触媒層A及び触媒層1の脱硝率が低下したため、触媒層2に濃度の高いNO_xが流入して、触媒層2の脱硝率が高くなっている。

c、触媒層3及び触媒層4の脱硝率特に変化はない。

【0014】(5) 脱硝装置清掃後1箇月の各触媒層負担率各触媒層負担率を図3に示す。これから触媒層A及び触媒層1の脱硝率が低下したため、濃度の高いNO_xが触媒層2に流入し触媒層2の脱硝反応が増加し触媒層2の負担率は、清掃直後と比較すると11%から44%と大幅に増加している。

【0015】(6) 脱硝装置清掃後1箇月後の未反応NH₃触媒層2、3、及び4の出口の未反応NH₃は、図3に示すようにそれぞれ5.4 ppm、2.9 ppm、1.3 ppmと順次低下している。最終触媒層4の未反

応NH₃は、空気予熱器の閉塞を防止するための制限値 (3 ppm) をクリヤしているものの脱硝装置清掃直後に比べてやや増加している。これは触媒層1、2の性能が低下したことに起因するものである。

【0016】性能の低下が特定された触媒層の内、石炭灰附着によるものについては、エヤー吹かし、触媒の破損欠落によるものについては定期修理での触媒取替、及び触媒そのものの経年劣化 (Na、K等による触媒の被毒等) については被毒物質の除去技術の確立 (触媒の再生) 等の対策が考えられる。尚図1の11は石炭灰捕集ホッパ、12はガス測定孔である。

【0017】

【発明の効果】本発明により

(1)触媒の性能低下状況の監視

(2)性能の低下した触媒の特定

が出来ることから、当該触媒層のエヤー吹かし等の処理により触媒性能の再生及び耐用命数の延伸が可能となつた。

【図面の簡単な説明】

【図1】(i) 図は本発明の複数触媒層の配置状態の側面図、(ii) 図は(i) 図中の本発明の排ガス測定孔、(iii) 図は(i) 図中の従来の排ガス測定孔である。

【図2】清掃直後の各触媒層の脱硝率、負担率及び未反応NH₃ 濃度図である。

【図3】清掃後1箇月後の各触媒層の脱硝率、負担率及び未反応NH₃ 濃度図である。

【図4】排煙脱硝装置の説明斜視図である。

【符号の説明】

6 排ガスダクト

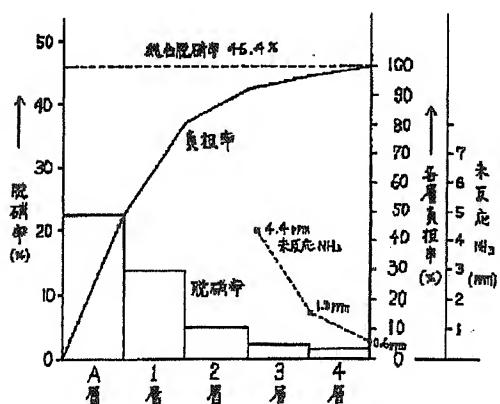
7 ボイラ燃焼炉

8 煙突

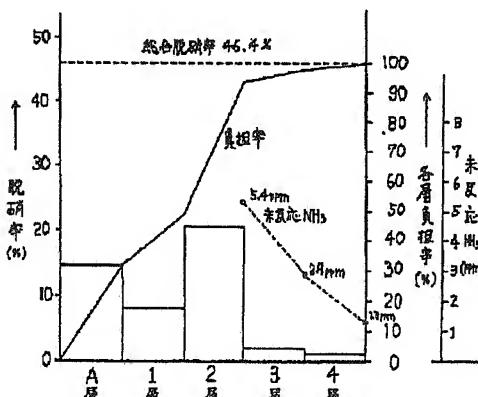
9 脱硝触媒層収容室

10 アンモニア供給管

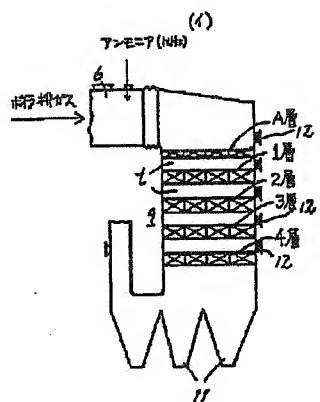
【図2】



【図3】



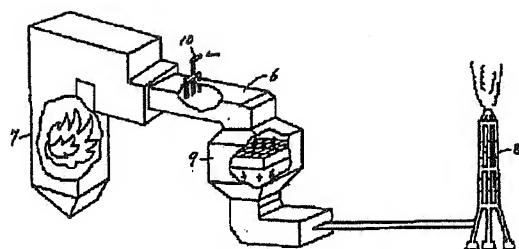
【図1】



(ロ)
排ガス测定孔(新設)

(ハ)
排ガス測定孔(既設)

【図4】



フロントページの読み

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